

# Characteristics of Humidifier Use in Korean Pregnant Women: The Mothers and Children's Environmental Health (MOCEH) Study

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**Objectives:** The current use of humidifier detergent and its harmful impact on humans has arisen as a societal environmental health issue. Therefore, in this study we aimed to explore the relationship between demo-socio characteristics and humidifier use, as well as the monthly usage changes in pregnant women; thus, we report the actual status of humidifier usage of Korea's pregnant population.

**Methods:** From a birth cohort of a Mothers and Children's Environmental Health (MOCEH) study, 1,144 pregnant women who responded through questionnaires including demo-socio characteristics, obstetric status and household environment including whether they use humidifier and frequency of use were included in this study. Statistical analyses were performed to explore the relationship between maternal characteristics and the relevance of the use of humidifiers was performed using a chi-square test, a t-test and univariate logistic regression analysis. The monthly usage rate was demonstrated in the graph.

**Results:** The humidifier usage rate in pregnant women was 28.2%. The average frequency of humidifier usage was 4.6 days per week, 7.3 hours per day. The usage rate was higher in the multipara group and the above the age of 34 age group than in the primipara and below the age of 34 groups. Seoul showed a higher usage rate than Cheonan and Ulsan and as the education level and income increased, the usage rate of humidifiers among pregnant women also increased. In the monthly trend of usage rate, the winter season showed the highest usage rate of over 45% and the lowest in late summer and beginning of fall with a value of 12% or less.

**Conclusions:** During pregnancy, the mother's body is especially vulnerable to hazardous environmental exposure that not only affects the pregnant woman but also the fetus. Further research is still needed to elucidate the route and effect of environmental risk factors. Therefore, based on precautionary and preventive principles, special interest and caution in harmful environments are strongly needed not only at an individual level but also at a national level.

**Key words:** Cohort study, Humidifier, Pregnant woman

## INTRODUCTION

The current use of humidifier detergent and its harmful impact on humans has arisen as a societal environmental health issue; however, it is still difficult to speculate the potential size of the exposed population because previous reports have not been carried out on the actual usage of humidifiers in households. While there is a limited possibility or low risk related to the use of humidifiers, there is potentially a greater danger in the harmful substances of the steam produced from the humidifier itself, which enters the lungs directly and causes a potential danger to human health [1]. Pregnant women and fetuses are known to be

vulnerable to harmful environmental exposure; if the use of a humidifier during pregnancy becomes a cause of risk exposure related to a particular health problem, then this can be regarded as an important environmental health concern.

In this study, we aimed to explore the relationship between demo-socio characteristics and the use of

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**Table 1.** Characteristics of study population related to use of humidifier

Characteristics	Total (n=1,144)		Use of humidifier (n=323)		OR (95% CI)	p-value <sup>b</sup>
	n	mean±SD or (%)	n	mean±SD or (%) <sup>a</sup>		
Age (y)	1,129	30.32 ± 3.72	317	30.67 ± 3.70	1.04 (1.00, 1.07)	<0.05
≤ 34	973	(86.2)	264	(12.7)	Ref	0.08
> 34	156	(13.8)	53	(16.7)	1.38 (0.96, 1.98)	
Pre-pregnancy body mass index (kg/m <sup>2</sup> )	1,039	21.22 ± 3.03	283	20.88 ± 2.89	1.00 (0.96, 1.05)	0.98
Parity						
Primipara	545	(56.4)	141	(25.9)	Ref	0.12
Multipara	422	(43.6)	129	(30.6)	1.26 (0.95, 1.67)	
Educational level						
≤ High school	307	(26.3)	77	(25.1)	Ref	<0.05 <sup>b</sup>
University	735	(65.9)	206	(28.0)	1.16 (0.86, 1.58)	
≥ Graduate school	73	(6.8)	29	(39.7)	1.97 (1.15, 3.36)	
Family income (million KRW)						
< 2	90	(8.2)	15	(16.7)	Ref	<0.03 <sup>b</sup>
2 - 3	798	(72.4)	227	(28.5)	1.99 (1.12, 3.53)	
≥ 3	211	(19.4)	67	(31.8)	2.33 (1.25, 4.35)	
Area						
Seoul	334	(29.2)	116	(34.7)	1.62 (1.16, 2.26)	0.01
Cheonan	352	(30.8)	87	(24.7)	Ref	
Ulsan	458	(40.0)	120	(26.2)	1.06 (0.79, 1.49)	
Frequency of using humidifier						
Days per week			299	4.61 ± 2.16		
Hours of using humidifier						
Hours per day			298	7.34 ± 4.40		
Hours per week			289	38.1 ± 34.15		

SD, standard deviation; OR, odds ratio; CI, confidence interval; KRW, Korean won.

<sup>a</sup> versus group of not using humidifier, <sup>b</sup>p for trend.

humidifiers and the changes in monthly usage by pregnant woman; thus, we aimed to report on the actual status of humidifier usage of Korea's pregnant population.

## MATERIALS AND METHODS

A total of 1,751 pregnant women were enrolled in a Mothers and Children's Environmental Health (MOCEH) cohort study initiated from May of 2006 until December of 2010 [2,3]. Using a questionnaire, trained nurses investigated the participants' characteristics such as demo-socio characteristics, previous medial history, current obstetric status, and environmental items and so on during pregnancy. Finally, 1,144 subjects who were asked questions on whether they use a humidifier and the frequency of its use were selected after excluding 29 subjects who refused to answer. This research was conducted after obtaining approval from the Institutional Review Board.

Statistical analyses were performed to explore the relationship between maternal age, region of residence, socioeconomic characteristics and parity, while the relevance of the use of humidifiers according to the characteristics was investigated by the chi square test, t-test and univariate logistics regression analysis using SAS version 9.2 (SAS Inc., Cary, NC, USA). In addition, in order to observe the changes in monthly usage rate, after completing statistical data the usage rate was demonstrated in a graph.

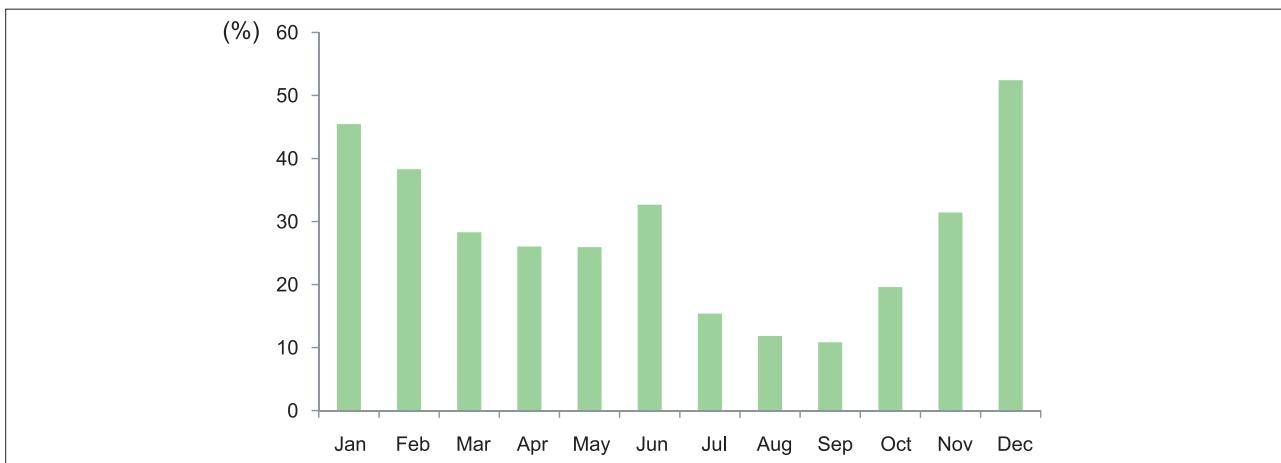
## RESULTS

The usage rate of humidifiers in pregnant women was 28.2%. The average usage frequency was 4.6 days per week, and the average usage time was 7.3 hours per day; thus the average usage hours per week was 38.1 hours.

When observing the characteristics of humidifier usage, the multipara group's humidifier usage rate was 30.6%, which was slightly higher than the primipara group. The humidifier usage rate in older aged pregnant women above the age of 34 was 4.0% higher than the women below the age of 34. When comparing the regional differences among cities, Seoul showed a higher usage rate than Cheonan and Ulsan.

In relation to the socio-economic characteristics of pregnant mothers, it was demonstrated that as the education level and income increased, the humidifier usage rate among pregnant women increased with statistical significance (Table 1).

Considering the monthly humidifier usage, the highest usage rate was in winter (in December and January) with a value of 45.5% and above, while the usage rate was at the lowest in late summer and the beginning of fall (in August and September) with a value of 12% or less. The monthly usage rate increased consistently after August, then it slowly decreased after December with a small rise in June, and then it showed a tendency to decrease up to September (Figure 1).



**Figure 1.** Monthly distribution on the use of humidifiers. Calculated from the number of humidifiers used / total number each month.

## DISCUSSION

Usually, pregnant mothers spend most of their time indoors, and the surrounding environment is considered to be an important environmental factor that will affect the pregnant woman and their growing fetus. In particular, maintaining adequate indoor humidity prevents dehydration of the indoor environment, preventing coughs and helping to relieve sensitive skin symptoms. However, several reports have claimed that the unclean use of humidifiers (whereby the sprayed mineral dust spreads and grows bacteria or microorganisms that live naturally in water) can possibly have negative effects on human health [1,4,5]. Consequently, the US Environmental Protection Agency prepared a fact sheet for the safe use and management of indoor humidifiers, and provided information that would protect human health against harmful environments [6].

Recently, the Korea Centers for Disease Control and Prevention claimed that deaths caused by lung injury with unknown causes are related to humidifier sterilizer (or detergent) [7-13]. According to the studies of 18 cases with case-control design, the odds ratio of lung injury occurrence was 47.3. In addition, through animal experiments which acted as a follow-up study, there have been reports of similar findings such as idiopathic pulmonary fibrosis in the relationship between the use of humidifier sterilizer and lung injury. Jeon et al. [14] reported that, from a mere regional cross-sectional research, the humidifier usage rate was 37.2%, 18% of which a humidifier sterilizer was used, and the monthly humidifier usage rate decreased after February and increased after October; these results were similar to those of this research.

However, this research result showed a slightly higher increase of humidifier usage rate in June, possibly because many humidifiers are purchased after May (a month where there were many reports related to observations of yellow dust), and because marriages increase in May (supported by

Population Statistical Data and its monthly marriage statistics from 2006 to 2011) [15]; it is therefore possible that the purchasing of humidifiers for newly-wed households contributes to the given result. The differences in the extent of the use of humidifiers according to socioeconomic characteristics or to the residential region are due to the purchasing power and information of household items including humidifiers, as well as the different market approaches to the sale of humidifiers. These results might be helpful in making guidelines and the delivery of further risk communication, focused on the selective target population at risk.

In this research, because the pregnant women subjects are recruited from three regions, including Seoul, Cheonan and Ulsan, it is difficult to generalize the result in terms of the scope of the entire region of Korea; furthermore, another limitation is that a detailed investigation on risk exposure characteristics has not been conducted. However, as a prospective research result for a cohort of the population, since research about the use of humidifiers in pregnant women is not very well known, this research will be able to contribute to estimating the potential endangered population.

This research observed that the population-sociological characteristics of pregnant women were related to humidifier usage characteristics, and that there were differences in the monthly use of humidifiers. During pregnancy, the mother's body is especially sensitive to harmful environmental exposure that not only affects the pregnant woman but also the fetus, and one of the factors that causing harm is considered to be the use of a humidifier. At the same time, further research on hazardous substances needs to be conducted that would demonstrate the route of the hazardous substance, and the cause of the effect on the target organ; through further research we might be able to understand how the substance operates in the human body. In conclusion, based on precautionary and preventive principles, wise caution is strongly recommended, as we need to provide

clean indoor environments at the individual level, and effective risk communication is also needed at the government level, in order to decrease health risk related to environmental hazards.

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## CONFLICT OF INTEREST

The authors have no conflict of interest to declare on this study.

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